November 18, 2019

EPA COMMENTS

on the

DRAFT FINAL REMEDIAL INVESTIGATION REPORT
HOMESTAKE MINING COMPANY SUPERFUND SITE

Operable Unit 1 – Tailing Seepage and Contamination of Groundwater Aquifers
Operable Unit 2 – Long-Term Tailings Stabilization, Surface Reclamation and Site Closure

Dated: September 30, 2019

General Comments:

1. Overall, there has been improvement in the quality of the maps and figures provided in the Draft Final Remedial Investigation Report (RI Report). The well identification numbers and values on the maps are legible, especially when enlarged.

2. Overall, the incorporation of sections for the EPA Phase 2 groundwater investigation report for the San Mateo Creek Basin Legacy Uranium Mines Site and the Homestake/ARCADIS background and supplemental background studies of 2018 and 2019 were good additions to the RI Report. EPA has only a few required revisions as noted in Specific Comments below.

3. EPA has issues with the structural geologic interpretations depicted on the two Electrical Resistivity Tomography (ERT) survey lines as EPA believes the usefulness of the lines for delineating the top of bedrock/base of alluvium, top and bottom of Chinle sandstone formations, and faulting is limited. However, EPA will make no further comment on the ERT lines herein.

4. There are no comments on the Baseline Ecological Risk Assessment (BERA). However, EPA's risk assessor is continuing to review the BERA and may have comments at a later time.

Specific Comments:

1. Section 1.4.2.2. – Removal of Windblown Contamination Areas

   The 5.0 picocurries per gram (pCi/g) and 15 pCi/g above-background soil standards for Radium 226 established in 40 CFR Part 192, Subpart B were used for the excavation of windblown contamination within and outside of the NRC Source Materials License boundary. These are potentially relevant and appropriate requirements for the part of the Homestake facility that

will remain under federal control when turned over to the DOE Legacy Management Program. For those areas that are outside of the License boundary, the CERCLA protective cleanup level for Radium-226 is based on risk assessment to achieve the EPA's acceptable carcinogenic risk range of 10-4 to 10-6. Therefore, please include additional documentation and discussion in the appropriate sections of the RI Report on Radium 226 concentrations measured in soil outside of the License boundary for the area of windblown contamination prior to soil reclamation and verification sampling. Additionally, include a summary discussion of the results from Appendix C (Completion Report for Reclamation of Off-Pile Areas at the Homestake Facility) on the residual Radium 226 levels. For example, there were 78 confirmatory soil samples collected that showed a mean concentration of 2.95 pCi/g and a standard deviation of 1.89 pCi/g for Radium 226, with a combined mean + standard deviation at the 95 percent confidence level of 3.5 pCi/g for Radium 226. Also indicate if there were any soil areas beyond the windblown contamination area that would exceed a health-based PRG for Radium 226.

2. Section 2.6.1.1 – San Mateo Alluvial Aquifer, page 2-7:

   a. EPA disagrees with the last sentence in the second paragraph on page 2-7, which states:

      "Because of the permeability of the sandstone, it is not believed that this bedrock ridge significantly interrupts or alters groundwater flow into the Site."

      First, Homestake has not provided supporting hydrogeological data (hydraulic conductivity, transmissivity, and sandstone permeability) for this statement. Second, Homestake does not know the areal and vertical extent of the bedrock ridge to the north or to the south of geologic boring BK-4. Historical well and geologic borehole data can be used to interpret the base of alluvium structure by mapping south of BK-4 but without conducting additional coring, the extent of the sandstone formation cannot accurately be defined. Until BK-4 was cored, the presence of this sandstone ridge was unknown and Homestake's conceptual site groundwater and geologic models for this area of the site were flawed. Third, the base of alluvium and top of bedrock contact at BK-4 is likely an erosion surface, with 18 feet of sandstone encountered in BK-4 on top of Chinle Group shale. How the thickness of the sandstone varies over this erosional surface is also not known. Lastly, and more importantly, the prominence (structural position) of the Chinle shale beneath the sandstone along this bedrock ridge and its significance as a barrier to groundwater flow is unknown. Today's water levels in the alluvial aquifer are artificially elevated, in part from Homestake's groundwater corrective action and likely in part from historical mine water discharges north of the Site that infiltrated and recharged the alluvium and flowed as groundwater downgradient into the alluvial of the lower San Mateo Creek basin floodplain area (*see* EPA's Phase 2 Groundwater Report for the San Mateo Creek Basin Legacy Uranium Mines Site, 2018). Homestake discusses the increased alluvial saturation from these two sources in the fourth paragraph on page 2-7. Historical water levels reported by Chavez (1961) for the alluvial aquifer are approximately 20 feet lower in the area of BK-4 than they are today. Considering the 1960 water levels as approximately pre-milling,

natural historical water levels for the alluvial aquifer, the bedrock ridge at BK-4 (i.e., the structural top of the Chinle shale within the ridge) likely becomes a more prominent physical barrier to alluvial groundwater flow and potentially causes a local branching of the alluvial aquifer. Such local branching of the alluvial aquifer occurs at the high bedrock feature located south and downgradient of the LTP (as discussed in the next paragraph of Section 2.6.1.1. In light of these concerns, please delete the last sentence of the paragraph.

b. EPA does not understand the reference to Figure 1-4 in the forth paragraph on page 2-7. Please verify it is the appropriate referenced figure and revise if it is not.

c. Please revise the fifth full paragraph on page 2-7 to discuss the relatively low hydraulic conductivities in the area south of the bedrock ridge at BK4. Hydraulic conductivity values range from 0.4 feet/day to 14.4 feet/day. These low values appear to be in the area of the bedrock ridge based on mapping of the base of alluvium structure. See Figure 1, below.

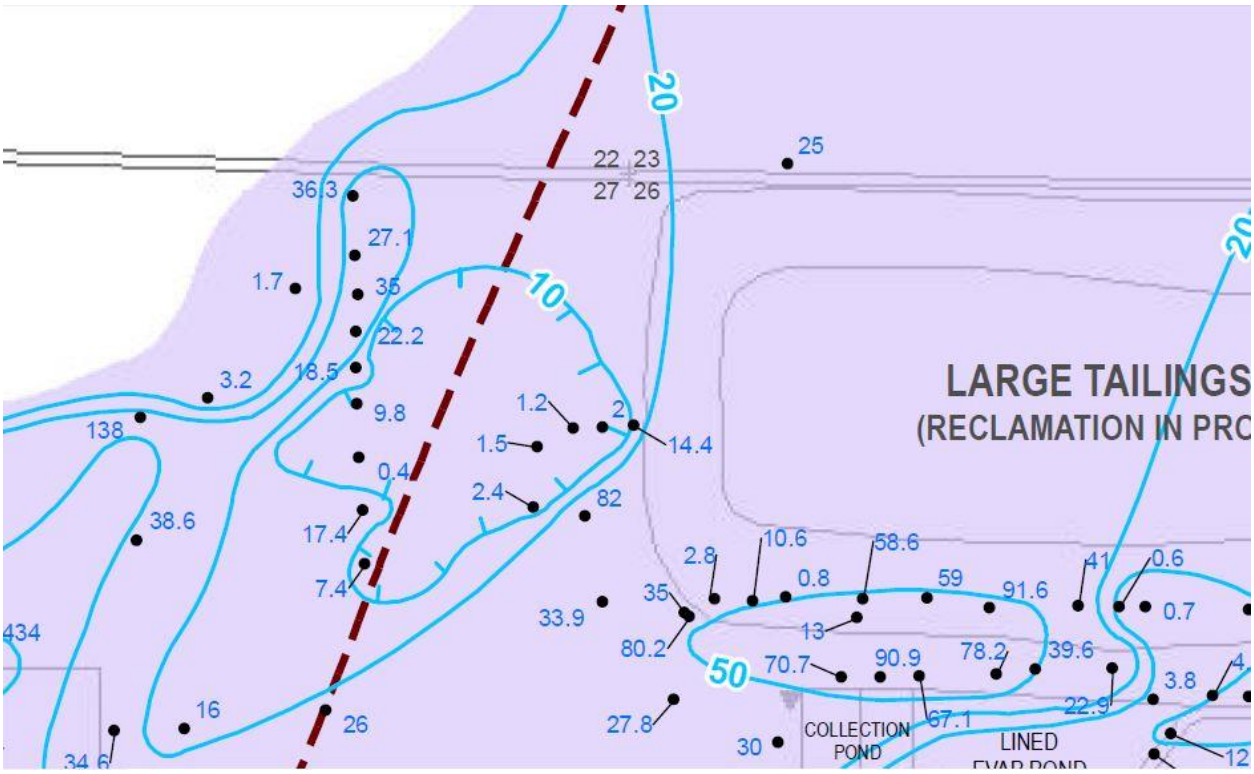

Figure 1 – Hydraulic Conductivity of the Alluvial Aquifer
(from Figure 3.2.2-4 of 2012 Corrective Action Plan)

3. Section 2.6.1.2 – Lobo Alluvium

In the first paragraph on page 2-8, please include a discussion of the Homestake/ARCADIS supplemental background study groundwater assessment in the BK3 and Well ND area and how such assessment may suggest Lobo Creek alluvial saturation is entering the San Mateo Creek alluvial channel in the area of BK3 and Well ND north of the LTP. In the Homestake/ARCADIS report, Section 3.2.1 – Geochemical Assessment (page 16, last paragraph), it states:

> *"The soluable sulfate here (BK3) is less depleted in sulfur 34, pointing to a source associated with recharge/runoff from Lobo Creek, including allochthonous gypsum."*

In Section 3.2.4 – Groundwater Assessment, page 24, Homestake/ARCADIS also states:

> *"Samples from wells BK1c, BK1f, BK2c, and BK2f fall in line with major ion chemistry at wells DD and P3, indicating that water chemistry changes across the basin are due to mixing of alluvial water in the main channel with input from the Lobo Creek drainage system in the east."*

4. Section 2.6.2 – Upper Chinle Aquifer, page 2-8:

   a. Please expand the discussion in the second paragraph on page 2-8 to discuss the sandstone encountered at BK4 during the supplemental background study. Also discuss whether Homestake considers the 18-foot thick sandstone bed that subcrops to the base of the alluvium at BK4 to be part of the Upper Chinle Aquifer or another Chinle sandstone aquifer. To support such discussions, please construct an east-west structural cross section using geologic borehole information from wells CW1, CW2-1, CW3, Chavez well no. 5, and boring BK4 as well as any other wells deemed appropriate to delineate the base of alluvium contact along the transect. It may also be appropriate to use the Electrical Resistivity Tomography (ERT) line to assist in cross-section construction. Plot water levels on the cross section, including the historic water level for the alluvial aquifer from 1960 (Chavez, 1961)

   b. Please include maps of the transmissivity and hydraulic conductivity for the Upper Chinle Aquifer in the RI Report to support the discussion of the last paragraph on page 2-8 and reference the appropriate figures.

5. Section 2.6.3 – Middle Chinle Aquifer

   a. Please include hydraulic conductivity and transmissivity maps for the Middle Chinle Aquifer and expand on Section 2.6.3 to discuss such properties in more detail (like those discussions for the Upper Chinle Aquifer).

   b. In the fourth full paragraph on page 2-10, it is unclear why there is a mixing zone for the Middle Chinle aquifer west of the west fault if the Middle Chinle groundwater upwells into the alluvial aquifer. Would not the mixing of Alluvial and Middle Chinle groundwater occuring in the alluvial aquifer downgradient of the subcrop area? It is stated in the paragraph that *"This prevents the alluvial aquifer from affecting the water quality of the*

Middle Chinle aquifer on the west side of the west fault." Please provide further clarification of the significance of the hydraulic connection and groundwater flow direction on water quality for these two aquifers west of the west fault.

6. Section 2.6.4 – Lower Chinle Aquifer

   Please include maps for hydraulic conductivity and transmissivity in the RI Report for the Lower Chinle Aquifer.

7. Section 2.7.1 – Phase 2 Ground-Water Investigation Report for the San Mateo Creek Basin

   Revise the last sentence of the second bullet beginning on page 2-13, and continuing onto page 2-13, to read as follows:

   "It is also important to note that pre-mining background water quality for uranium and selenium are not available, which makes it difficult to establish that the plumes are the result of a release without using other lines of evidence."

8. Section 2.7.3 – Supplemental Background Soil and Groundwater Investigation Report, page 2-14:

   a. Revise the second sentence of the last bullet to read as follows:

      "There is evidence that the sandstone is permeable."

9. Section 3.1.2 – Homestake Facility Secondary Sources, page 3-1:

   The bullet statement at the end of the page appears to be incomplete. Please revise.

10. Section 3.2.1.1 – Chemicals and Radionuclides of Potential Concern and Cleanup Levels Developed for NRC License, page 3-8:

    a. See Specific Comment No. 5.b, above, regarding Mixing Zone as it pertains to the discussion in the fourth paragraph. Modify the fourth paragraph if appropriate to clarify the issue raised in 5.b.

    b. Revise the sentence at the top of page 3-10 as follows:

       "For the purposes of this RI, the NRC Site Cleanup Levels will be considered preliminary remediation goals (PRGs) for groundwater unless directed otherwise by EPA. EPA is currently reassessing the appropriateness of the NRC Site cleanup levels for groundwater and may decide to modify some cleanup levels for some aquifers."

11. Section 5.2.1.1 – Current and Future Land Use

In the last paragraph of this section, Homestake discusses a draft deed restriction that prohibits residential and agricultural use of the LTAs. EPA has received the draft deed restriction, which is entitled "Declaration of Institutional Controls", for review.

12. Section 5.2.1.4 – Potential Routes of Migration, page 5-5:

    Please revise key sentences in this section to indicated that the deed notice, if selected as part of a remedial alternative by EPA, would prohibit residential and agricultural land uses and ground water use. As written now, it states that such land uses "are" restricted.

13. Figure 2-21 – Base of Alluvial Contour Map

    The base of alluvium structure contour map still does not honor the data points at many locations. See Figure 2, below, which shows the well data points not honored by the contour lines in the area of BK4. As an example of a mapping effort that honors the data points, EPA has recontoured the area near BK4 (*see* Figure 3 below). EPA has previously requested that this area of the Site be recontoured using the Supplemental Background Study data, as well as any additional geologic boring data that may have been collected, and at a larger scale to show better detail of the base of alluvium structure. Such mapping should help delineate the bedrock ridge encountered at BK4.

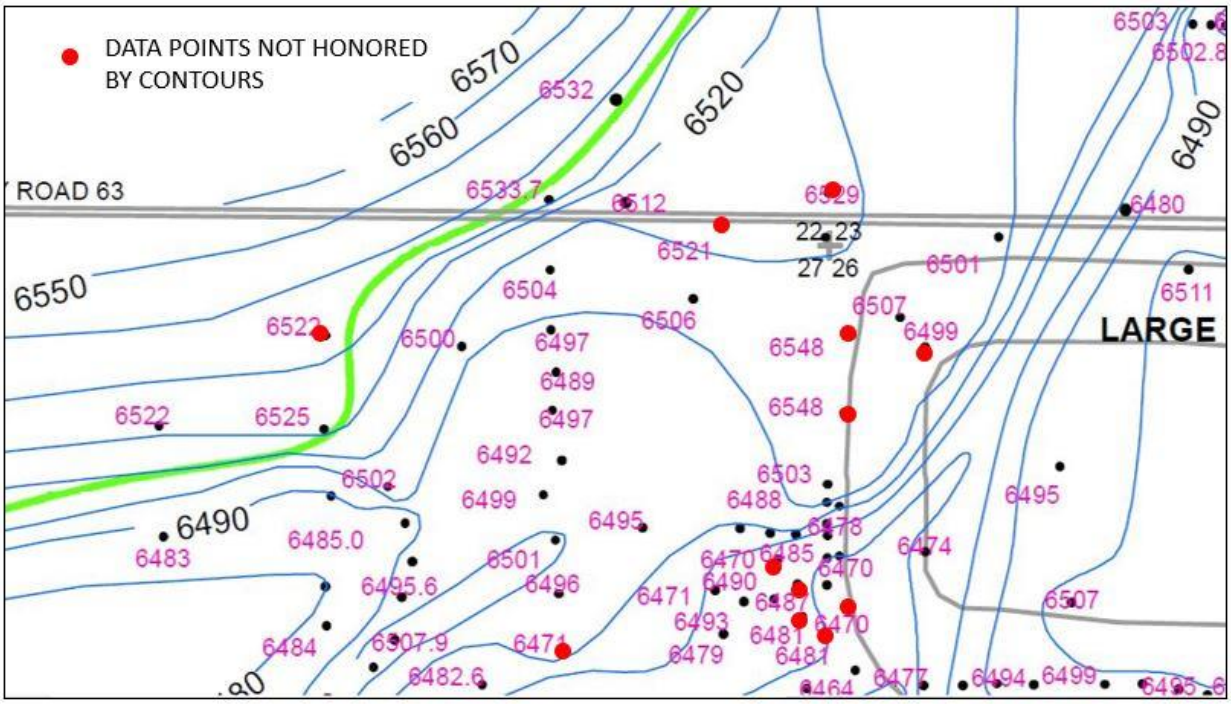

Figure 2

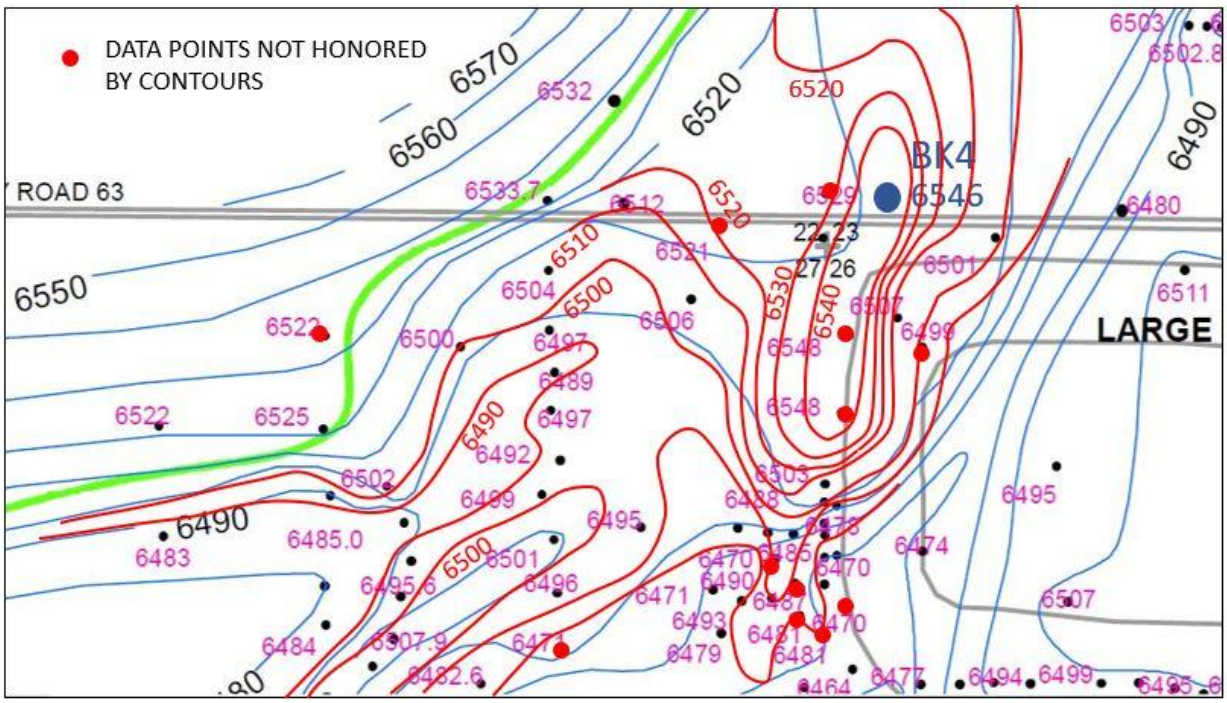

Figure 3

14. Table 5-1 – Data Sets Evaluated, page 5-2

    HMC-1OFF air monitoring station location was referred to as a background location.

    EPA and NRC disagreed with this location as an air background location to the site. Please use the NRC and EPA accepted background air location of HMC-16 as the only acceptable air background for the site.

15. Section 5.2.1.1 – Current and Future Land Use, page 5-4, first paragraph:

    It was reported that the deed restriction will be added in the final RI report.

    EPA is currently reviewing the deed restriction.

16. Table 5-3 – Conceptual Site Model for Human Receptors for Land Treatment Areas, page 5-9:

    Please add to this model, the past practices of irrigating and flooding the fields at the LTA with contaminated groundwater. These practices ended up contaminating surface soil and groundwater at the LTA.

17. Section 5.2.2.2.4 – Air, page 5-14:

    It was reported that Homestake Facility and LTA outdoor air data were combined.

EPA is not aware of any outdoor air monitoring at the LTA. Please explain.

18. Table 5-7 – Composite Worker RadPRGs for Ambient Air, page 5-15:

    It was not clear why U-234 and U-238 were not included in this table.

19. Section 5.2.2.4 – Screening Results, Soil, page 5-15:

    It was reported that background raw data were used to estimate background threshold values (BTVs) with ProUCL.

    It was not clear what value is selected as BTV (i.e. geometric mean, UCL 95%, median etc…). Background data are usually homogenous and arithmetic mean is enough to measure central tendency of the data. If the data is not homogenous, then the same statistics used for the site should be used for the background value (i.e. UCL95% for site should be compared with UCL95% background). When comparing to background data, EPA guidance also recommends comparing the two data sets using hypothesis testing to detect significant differences between background and onsite contaminant concentrations.

20. Footnote to Table 5-11, page 5-29:

    Correct the foot note on CS to refer to Table 5-12.

21. Section 5.2.1.5.4 – Comparison to Background, page 5-52:

    Soil: Need to explain background threshold value (BTV). How it was determined. What type of statistics was run through the data? Why it was considered adequate to compare to site data?

    Air: A new term was used “upper simultaneous limit (USL)” defined as representative value for a maximum background concentration and used as a BTV for air concentration.

    It is unacceptable to use the maximum background level to compare to 95% UCL value of site data. Need to use the 95%UCL on the arithmetic mean for background data to compare with the 95% UCL on arithmetic mean of background data.

22. Table 5-19 – Surface Soil Background and Homestake Facility Soil Comparisons, page 5-53:

    The table heading should reflect air and not surface soil.

    The number representing the maximum air value was used as BTV for air. The 95% UCL on the arithmetic mean using ProUCL for HMC-16 should be used instead for calculating the ratio of site to background level.

23. Table 5-20 – Surface Soil Background and Homestake Facility Soil Comparisons, page 5-54:

    a. The statistics used to calculate the BTV for soil was different from the statistics used to calculate the site data. The site and background data should be using the same statistics to properly compare the two data sets. EPA recommends using the 95% UCL on the arithmetic mean using ProUCL model or equivalent model to calculate the one value representing the areas of exposure.

    b. Under "Retain COPC or ROPC?" column a symbol of HQ was provided without explaining what it stands for in the footnotes. If it is meant for Hazard Quotient, then this cannot be used for ROPC since HQ is used for non-carcinogens and ROPC evaluated based on cancer effects. Please adjust.

    c. In the footnote a "+D" notation was added. Please provide which ROPC screening included their progenies.

24. Table 5-21 – Surface Soil Background and Land Treatment Areas Soil Comparisons for the RI HHRA, page 5-57:

    Same first two comments as comment No. 23 for Table 5-20 above.

25. Table 5-22 – Radon in Air Background Compared to Site Activity, page 5-60:

    HMC-1OFF was referred to as background air monitor. EPA and NRC do not recognize HMC-1Off as a background air monitor. Please remove from the table.

    Remove the USL value for HMC-16 air monitor as a background level and retain the HMC-16 UCL95 value as a background level for the site.

26. Section 5.2.5.2 – Risk Description, page 5-61, second paragraph:

    It was reported that "The inherent risks due to background exposure, whether Site concentrations exceed background as indicated by the ratio of the UCL95 to the BTV,…"

    Similar statistics must be used for comparing site concentrations to background concentrations. Using site representative average value to compare to background representative maximum values is not adequate.

27. Section 5.2.5.2.1 – Future Composite – Worker Homestake Facility, page 5-61, second paragraph:

    - It was reported that "Risks due to radon, once background is accounted for, are in the range of no excess risk to 2 x 10^{-2}, above the risk management range."

Risk was calculated as a risk range due to the use of two separate radon background concentrations. Use only the 95%UCL on the arithmetic mean of 551 pCi/m3 as a background air level and report the risk without using a range.

- I got a risk of 7.7E-03 or rounding it to 8E-03 rather than the 2E-02. Please check your calculations.

- This section seems to indicate that outdoor radon was evaluated separately than indoor air for a composite worker. Composite worker scenario assumes exposures to both outdoor air and indoor air. Therefore, EPC of 1074 pCi/m3 which is calculated for both outdoor and indoor radon air concentrations should be used for this exposure scenario.

28. Section 5.2.5.2.1 – Future Composite Worker – Homestake Facility, page 5-61, third paragraph:

    It is reported that "Consultation with EPA indicated that risk cannot exceed 1, and the RadPRG calculator defaults to a different model above this point. There may be a discrepancy in risk estimates due to use of different models simply because background risks for radon, even after daughter progeny below Po-214 are removed, are so high. The EPCs for background and the outdoor air at the Site are similar, and risk estimates are also expected to be similar."

    The RadPRG calculation defaults to a different model above an excess high cancer risk of 1E-02 and not 1. A one-hit equation model is usually used instead.

    EPA disagrees that the EPCs for background and the outdoor air at the Site are similar. The UCL95% on the arithmetic mean for the site over a period of at least 4 years was estimated at 949 pCi/m3 whereas the UCL95% on the arithmetic mean for the background area was estimated at 551 pCi/m3. This increase in outdoor radon concentration is expected to have an additional excess cancer risk of 8E-03 over background levels.

29. Section 5.2.5.2.1 – Future Composite Workerr – Homestake Facility, page 5-62, first paragraph:

    Please remove the whole paragraph. It is not relevant to the baseline risk assessment.

    The baseline risk assessment is an analysis of the potential adverse health effects (current or future) caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these releases (i.e., under an assumption of no action).

30. Section 5.2.5.2.2 – Future Construction Worker – Homestake Facility, page 5-62, fourth paragraph:

    It is reported that "…and outdoor air based on all data combined from 2014 through 2018 from the HF and LTAs. The indoor air was used to represent potential trench air radon levels. The

total cumulative cancer risk for air is 2 x 10^{-1}, which is above the upper bound of the risk management range.

- To my knowledge there was no outdoor air data from LTA. Please explain.

- The total cumulative cancer risk from air was reported at 2E-01. Table 5-25 shows a risk of 8E-04. Please adjust.

It is reported that "When inherent background is subtracted out of the total risk, the cancer risk attributable to the Site ranges between no excess risk to 4x10^{-4}, which is acceptable to above the risk management range."

It was not clear where the excess cancer risk of 4E-04 was estimated. Table 5-25 provide a different excess cancer risk. Please remove a range of excess cancer risk from no risk to 4E-04. Use only one value for the background which is the 95%UCL value. Take out the statement "which is acceptable to above the risk management range". Excess cancer risk of 4E-04 is not an acceptable level. This is left later for risk management decision.

31. Section 5.2.5.2.2 – Future Construction Worker – Homestake Facility, page 5-62, last paragraph:

    It is reported that "A significant part of the cancer risk is related to Site background radon levels (refer to Table 5-25). Radon activity in outdoor air (949 pCi/m3) at the Homestake Facility is slightly higher than outdoor background concentrations of 551 pCi/m^3 based on a UCL95, and similar to the BTV of 996 pCi/m^3 based on the data from HMC-16. Assuming trench air radon activities are as high as Site indoor air which is 1.837 pCi/m^3, estimated trench air concentrations are less than the predicted Cibola County average indoor air value from EPA (2019d) of 2000 - 4000 pCi/m^3."

    The excess cancer risk from outdoor background concentration of 551 pCi/m3 was not reflected in Table 5-25. Please provide the risk associated with this level of radon exposure. Remove the BTV value of 996 pCi/m3 since it was based on unsupported Value (representative of maximum value) by EPA guidance when comparing to background data.

32. Section 5.2.5.2.4 – Future Composite Worker – Land Treatment Areas, page 5-63:

    Please refer to comments provided above (comment No. 27) on Future Composite Worker Homestake Facility.

33. Section 5.2.5.2.4 – Future Composite Worker – Land Treatment Areas, page 5-64, second paragraph:

    It is reported that "There is also a UCL95 radon concentration of 3,410 pCi/m3 from Valle Verde from EPA (EPA 2014a), but the HMC data are more recent."

Please remove this statement from the report. Since indoor radon in the offsite residential area was not attributed to site related sources. But it was more attributed to type of house structure as to the potential source of indoor air radon gas levels.

34. Section 5.2.5.2.4 – Future Composite Worker – Land Treatment Areas, page 5-64, third paragraph:

    It is reported that "Radon concentrations in air are high enough that risk estimates may exceed 1, and when this occurs the EPA ORNL RadPRG calculator defaults to using a different model to predict risk. Therefore, differences in risk estimates between HMC16, Site outdoor air, and combined Site indoor/outdoor air may be indistinguishable. Note that radon in outdoor air (949 pCi/m^3) is, however, slightly lower or similar to the BTV at HMC-16 (996 pCi/m^3) (Table 5-22) and slightly higher than a UCL95 of 551 pCi/m^3 for HMC-16. Excess risk attributable to the Site ranges from no excess risk to $1x10^{-2}$."

    Please see comment No. 28 above.

35. Section 5.2.5.2.4 – Future Composite Worker – Land Treatment Areas, page 5-64, last paragraph:

    It is reported that "There is limited excess risk attributable to the Site once ambient conditions are accounted for given that subtracting inherent background risk from the Site risk produces a negative number. The LTAs therefore do not appear to have an unacceptable cancer risk for this receptor"

    Two paragraphs above it was reported that "Excess risk attributable to the Site ranges from no excess risk to $1x10^{-2}$. Please remove the last sentence "The LTAs therefore do not appear to have an unacceptable cancer risk for this receptor"

36. Section 5.2.5.2.5 – Future Construction Worker – Land Treatment Areas, page 5-64:

    - It is reported that "The total cumulative cancer risk is $4x10^{-5}$. This is estimated as the sum of the surface soil pathways at exposure times of 8 hours per day and soil ingestion rates of 330 mg/d plus the sum of the fugitive dust air pathways. External exposure is the only exposure pathway with elevated risks for the soil contact pathways for this receptor."

    Table 5-34 had a different cumulative cancer risk, from exposure to soil, than the 4E-05. Please adjust.

    - It is reported that "The major risk driver is radon for risks estimated for the inhalation pathway from measured air concentrations; all other estimated cancer risks fall below the upper bound of the risk management range. Rn-222 risks are elevated for exposure to the

Site-wide outdoor and indoor air concentration of 1,074 pCi/m^3. This concentration was used to represent exposure to outdoor and trench air concentration. Once background is subtracted from the Site risk, there is little to no excess risk attributable to the Site, since risks for the Site and BTV are both 8 x 10^{-4}. Excess risk (Table 5-34) attributable to the LTAs is zero to 4x10^{-4}."

The BTV value for radon background should not be used to compare with site radon data. The BTV is a representative value for the maximum value. Please use the 95%UCL on arithmetic mean value of 551 pCi/m3 to compare with the 95%UCL on arithmetic mean for site data.

Please remove the risk range attributable to the LTAs and provide only one value. The 4E-04 excess cancer value was not reported in Table 5-34. Please report the risks in the table associated with the site data and the inherent background data and the difference attributable to the site.

- It was reported that "The excess cancer risk attributable to the Site surface soils and air exposure pathways is similar to or less than that due to background. Any cancer risks are largely due to radon in air."

This statement is not true for air exposure pathways since site air radon concentrations were almost double that of the background air radon data.

37. Section 5.2.5.2.7 – Potential Risk Estimates for Post-Remedy Groundwater, page 5-81:

Evaluation of residual risk from exposure to chemicals of potential concern (COPC) and radionuclides of potential concern (ROPC) in groundwater at their proposed clean-up levels showed that the estimated excess cancer risk and non-cancer risk is much higher than the EPA's generally accepted risk levels. Therefore, some means, to prevent groundwater use in the future, need to be put in place post groundwater remedy.